53½° at 3h. 15m. P.M. to 46° by 4h. P.M., and to 43° by 5h. P.M.); and the direction of the wind immediately changed to the amount of 90°, following the direction of the sun, or from S.S.W. to W.N.W.

At the Radcliffe Observatory, Oxford, the barometer-reading at 6h. A.M. was 29·18 in., and decreased to 28·80 in. at 2h. 30m.; it then suddenly increased to 28·85 in. at 2h. 35m., and to 29·25 in. by 11h. P.M. At 2h. the direction of the wind was S.; at 3h. 30m. it was W., and continued W. till 4h. 30m., and then returned to S.W. by 5h. The temperature at 2h. was 51°, declined to 43° at 2h. 30m., and to 41° by 5h.

The general changes of temperature agree very closely with those at Greenwich; but, as in the case of the barometer, those at Oxford preceded those at Greenwich by one hour nearly.

The general fact frequently noticed of a change in the direction of the wind simultaneously with a sudden and great pressure, and for the most part in one direction (that is to say, in the direction of the sun's motion, or N. to E. to S.), is very remarkable, and not easily accounted for.

November 30, 1863.

ANNIVERSARY MEETING.

Major-General SABINE, President, in the Chair.

Dr. Alderson, on the part of the Auditors of the Treasurer's Accounts, reported that the total receipts during the past year, including a balance of £635 7*s.* 3*d.* carried from the preceding year, amounted to £5133 10*s.* 3*d.*, and that the total expenditure in the same period amounted to £4475 10*s.* 2*d.*, leaving a balance at the Bank of £641 14*s.*, and in the hands of the Treasurer of £16 6*s.* 1*d.*

On the motion of Sir Andrew S. Waugh, seconded by Mr. Hudson, the thanks of the Society were voted to the Treasurer and Auditors.

The Secretary read the following Lists:—

Fellows deceased since the last Anniversary.

On the Home List.

Beriah Botfield, Esq.
Loftus Longueville Clarke, Esq.
Prof. Arthur Connell.
Edward J. Cooper, Esq.
Walter Ewer, Esq.
Joshua Field, Esq.
Richard Fowler, M.D.
James William Gilbart, Esq.
Joseph Glynn, Esq.
Peter Hardy, Esq.
John Jesse, Esq.
Henry, Marquis of Lansdowne.
John Singleton Copley, Lord Lyndhurst.
John Gorham Maitland, Esq.
Richard Penn, Esq.
Clement Tudway Swanston, Esq.
John Taylor, Esq.
William Tooke, Esq.
James Tulloch, Esq.
Rev. William Walton.
Rear-Admiral John Washington.
Alexander Wilson, Esq.

On the Foreign List.

César Mansuète Despretz. | Eilhard Mitscherlich.
Carl Rümker.

Withdrawn.

Edward John Littleton, Baron Hatherton.
Lieut.-General William Monteith.

Fellows elected since the last Anniversary.

On the Home List.

The Right Hon. Edward Pleydell Bouverie.
Edward William Cooke, Esq., A.R.A.
William Crookes, Esq.
Col. Frederick M. Eardley-Wilmot, R.A.
James Fergusson, Esq.
Frederick Field, Esq.
Rev. Robert Harley.
The Right Hon. Sir Edmund Walker Head, Bart.
John Russell Hind, Esq.
Charles Watkins Merrifield, Esq.
Professor Daniel Oliver.
Frederick William Pavy, M.D.
William Pengelly, Esq.
Henry Enfield Roscoe, B.A.
Rev. George Salmon, D.D.
Samuel James Augustus Salter, M.B.
Rev. Arthur Penrhyn Stanley, D.D.
William Thomson, D.D., His Grace The Archbishop of York.

Readmitted.

Capt. L. L. Boscawen Ibbetson.

On the Foreign List.

Ernst Eduard Kummer. | Heinrich Gustav Magnus.
Johannes Japetus Smith Steenstrup.

The PRESIDENT then addressed the Society as follows:—

GENTLEMEN,

WHEN I had last the honour of addressing you at the Anniversary Meeting in 1862, I acquainted you that a communication had been received by your President and Council from the Duke of Newcastle, Her Majesty's principal Secretary of State for the Colonies, requesting the opinion of the Royal Society on the scientific importance of the results to be expected from the establishment of a Telescope of great optical power at Melbourne, in the Colony of Victoria, for the observation of the nebulæ and multiple stars of the Southern Hemisphere. The communication was founded on a despatch from Sir Henry Barkly, K.C.B., Governor of Victoria, soliciting on his own part and on that of the Visitors of the Melbourne

Observatory, the opinion of the Royal Society on this subject, and also on the most suitable construction of the telescope, both as to the optical part and the mounting, its probable cost, and the time required for its completion. It had happened that in 1853 the Royal Society and the British Association had united in an earnest representation to Her Majesty's Government of the scientific importance of establishing in some convenient locality in Her Majesty's dominions, from whence the southern nebulæ and multiple stars could be observed, a telescope of the requisite optical power; and in a preparatory correspondence, which was printed at the time, and in which the principal persons interested in such researches had participated, the best form of telescope, its probable cost, and all particulars relating to it, had been largely discussed. The representation thus concurred in by the two principal scientific bodies of the United Kingdom was not successful in securing the desired object; but the correspondence then printed was still fitted to supply in great measure in 1862 the information on which the President and Council could ground their reply. The discussion in 1853 had terminated in the appointment of a committee, consisting of the Earl of Rosse, Dr. Robinson, and Messrs. Lassell and Warren de la Rue, to superintend the construction of the telescope, in the event of the recommendation of the two Societies being favourably received. But as it was possible that the opinions previously entertained might have been in some degree modified by subsequent consideration or by more recent experience, the correspondence with those gentlemen was reopened, and their replies have formed a second correspondence, which, like the first, has been printed for the information of those Fellows of the Society who take a special interest in the subject. Availing themselves of these valuable communications, the President and Council replied to the Colonial Office by a report dated December 18, 1862. They have been since informed that copies of the report and of the correspondence have been sent to Melbourne for the information of the gentlemen with whom the proposition originated.

It is quite possible that the thoughtful discussions embodied in the correspondence referred to may be found to have a prospective value not limited to the occasion which has given rise to them. The considerations which apply to a telescope for the observation of the Southern Nebulæ at Melbourne are no less applicable to one which might be established on a site from whence a great part of the Southern Nebulæ could also be observed (as well as those of our own hemisphere), but enjoying the immense advantage conferred by elevation into the higher and less dense strata of the atmosphere. Such sites are to be found in the Nílgiris at elevations of several thousand feet, combining also convenient accessibility and proximity to the resources of civilized life. It may be hoped that at some not distant day the subject will receive the consideration which it deserves from those who are entrusted with the government of that now integral part of the British empire.

Having learnt that a series of pendulum experiments at the principal stations of the Great Russian Arc were in contemplation, I availed myself of an opportunity of informing M. Savitsch, by whom the operations were to be conducted, that the Invariable Pendulums which had been employed in the English experiments were now in the possession of the Royal Society, and, being unemployed, would, I was persuaded, be most readily lent by the Society on an application to that effect being made. The constants of these instruments, including the coefficient in the reduction to a vacuum, having been most carefully determined, they were ready, with the clocks and stands belonging to them, for immediate use, and would have the further advantage, that experiments made with them in Russia would be at once brought into direct connexion with the British series extending from 79° 50′ N. to 62° 56′ S. latitude. The communication was most courteously received and replied to. It appeared, however, that a detached invariable pendulum had been already ordered by the Russian Government from M. Repsold, of Hamburg, shorter than the English pendulums for convenience in land transport, and with two knife-edges and two fixed lenses, symmetrical in size and shape but one light and the other heavy, and so arranged that the times of vibration should be the same on either knife-edge in air of the same temperature and density. M. Savitsch expressed his desire to bring this pendulum in the first instance to Kew, and to secure thereby the connexion of his own with the English series, where also he would have the opportunity of testing the exactness of the correction for buoyancy by vibrating his pendulum on both its knife-edges in the vacuum-apparatus which is now established at Kew.

It is much to be desired that a similar series of pendulum experiments to those about to be undertaken in Russia should be made at the principal points of the Great Indian Arc; and the steps which are understood to be in progress in providimg new instruments for the verification of the astronomical and geodesical operations of the Trigonometrical Survey of India, and to give them a still greater extension, would seem to present a most favourable opportunity for the combination of pendulum experiments. In such case the pendulums of the Royal Society might be made available with excellent effect.

The large size of our printed volumes in the present year gives no unfavourable and, I think, no unfair idea of the present scientific activity of the Society; for I believe it may be safely said that our Council has not been less vigilant and cautious than heretofore in the selection of the papers to be printed. Although much care has been given to keeping the expenses of illustration within reasonable bounds, the cost of the Society's publications has been this year unusually high; yet I am glad to be able to state that our whole expenditure within the year has fallen within our income. With your permission, I will briefly advert to a few of the subjects which have occupied the Society's attention in the past year.

The researches of Kirchhoff and Bunsen have rendered it in a high degree probable that we shall be able to obtain much insight into the chemical nature of the atmospheres of the brighter fixed stars, by observing the dark lines in their spectra and comparing them with the bright lines in the spectra of elementary, and perhaps also of compound, bodies in the state of incandescent gas or vapour. The interest of such an inquiry is obvious; but the difficulties involved in it are very great. The quantity of light coming from even such a star as Sirius is so small, that without the use of a powerful telescope the spectrum obtained would be too faint to bear sufficient enlargement to show properly the fixed lines. The apparent diurnal motion of the stars causes much embarrassment, unless the instrument be mounted equatoreally, and furnished with a clock movement. The control of the experiments on incandescent bodies requires a thorough knowledge of chemistry, so as to avoid being misled by impurities in the substances examined, and to be prepared to interpret decompositions or combinations which may take place under unusual circumstances, and which may be manifested only by their effects. Nor can the astronomical and physical parts of the inquiry be well dissociated, so as to be separately undertaken by different individuals; for the most elaborate drawings can hardly convey a faithful idea of the various aspects of the different dark and bright lines, which yet must be borne in mind in instituting a comparison in cases of apparent coincidence. It is fortunate, therefore, that the inquiry has been taken up by two gentlemen working in concert. In a short paper read to the Society on the 26th of last February, and published in the Proceedings, Mr. Huggins and Dr. Miller have described and figured the spectra of three of the brighter stars; and this part of the inquiry will doubtless be continued. In a paper since presented to the Society, Mr. Huggins describes the means employed for practically determining with accuracy the positions of any stellar lines which may be observed, with reference to known points of the spectrum, and has given beautiful maps of the spectra of twenty-four of the elementary bodies under the action of the inductive discharge, reserving others for a future communication. When the inquiry is completed, it is possible that we may obtain an amount of knowledge, respecting the constitution of those distant heavenly bodies, of which we have at present little conception.

Professor Tyndall has given us the fourth of a series of papers upon the relation of Gases and Vapours to Radiant Heat. In the course of these inquiries, he has shown that the different aëriform bodies, even though colourless, exert very different degrees of absorptive action on the rays of heat,—and that certain portions of these heat-rays are more powerfully absorbed than others—rays from objects at a low temperature being more easily absorbed than those from objects at an elevated temperature. He has also proved that gases radiate as well as absorb, and, in conformity

with what is known in the case of solids, that in gaseous media also there is equality in the powers of radiation and absorption. Bodies which exert an absorbent effect in the liquid form preserve it in the gaseous state. If further experiments should confirm Prof. Tyndall's views upon the absorptive action of aqueous vapour upon radiant heat of low intensity, these results must materially modify some of the views hitherto held upon the meteorological relations of aqueous vapour.

The Bakerian Lecture, by Mr. Sorby, is entitled by him "On the Direct Correlation of Mechanical and Chemical Forces." In this paper are embodied a series of observations upon the influence of pressure upon the solubility of salts, in which he has obtained results analogous to the changes observed in the freezing-point of liquids under pressure. He finds, in cases where, as is usual, the volume of the water and the salt is *less* than the volume of the water and the salt separately, that the solubility is *increased* by pressure, but that, in cases where (as when sal-ammoniac is dissolved in water) the bulk of the solution is *greater* than that of the water and salt taken separately, the solubility is *lessened* by a small but measurable amount. On the contrary, salts which expand in crystallizing from solution must, under pressure, overcome mechanical resistance in that change; and as this resistance is opposed to the force of crystallization, the salt is rendered more soluble. The extent of the influence of pressure, and the mechanical value of the force of crystalline polarity, were found to vary in different salts. Mr. Sorby also indicates the results of the action of salts upon certain carbonates under pressure, and purposes pursuing his researches upon chemical action under pressure. This paper may therefore be regarded as the first of a series upon a highly interesting and important branch of investigation, for which Mr. Sorby appears to be specially fitted, from his combining the needful geological knowledge with the skill in manipulation required in the physical and chemical part of the inquiry.

The examination of the bright lines in the spectra of electric discharges passing through various gases, and between electrodes of various metals, has of late years attracted very general attention. Each elementary gas and each metal shows certain well-marked characteristic lines, from the presence or absence of which it is commonly assumed that the presence or absence of the element in question may be inferred. But the question may fairly be asked, Has it been established that these lines depend so absolutely on chemical character that none of them can be common to two or more different bodies? Has it been ascertained that, while the *chemical nature* of the bodies remains unchanged, the lines never vary if the circumstances of mass, density, &c. are changed? What evidence have we that spectra are superposed, so that we observe the full sum of the spectra which the electrodes and the medium would produce separately?

To examine these and similar questions in the only unimpeachable way

(that of actual experiment) formed the object of a long and laborious research by Dr. Robinson, the results of which are contained in a paper in our Transactions. In the course of this research, Dr. Robinson had occasion to take careful measures of the positions of all the bright lines visible (and not too weak to measure) in a great number of spectra—those, namely, of the induction discharge passing between electrodes of twenty different metals, as well as graphite, most of which were observed in each of five different gases (including air), and for each gas separately at the atmospheric pressure and at the low pressure obtained by a good air-pump.

On taking an impartial survey of this great assemblage of experimental facts, Dr. Robinson inclines to the opinion that the origin of the lines is to be referred to some yet undiscovered relation between *matter in general* and the transfer of electric action; and that while the *places* of the lines are thus determined independently of particular circumstances, the *brightness* of the lines is modified, according to the special properties of the molecules which are present, through a range from great intensity down to a faintness which may elude our most powerful means of observation.

By a discussion of the results of the magnetic observations maintained for several years past at the Kew Observatory with an accuracy previously unattained, and by combining these with the earlier results of the observations at the British colonial observatories, I have been enabled to trace and, as I believe, satisfactorily to establish the existence of an annual variation in the three elements of the earth's magnetism, which has every appearance of being dependent upon the earth's position in her orbit relatively to the sun. Substantiated by the concurrent testimony of observations in both hemispheres, and in parts of the globe most widely distant from each other, this conclusion furnishes an additional evidence of a cosmical magnetic relation subsisting between the earth and other bodies of the solar system, and thus extends the scope and widens the basis of sound induction upon which the permanent relations of magnetical science must rest.

To Dr. Otto Torell, Professor of Zoology in the University of Lund, we are indebted for a communication of much interest, informing us of the progress made by an expedition appointed by the Swedish Government at the recommendation of the Royal Academy of Sciences at Stockholm, to execute a survey preliminary to the measurement of an arc of the meridian at Spitzbergen. The objects of the preliminary survey were to ascertain whether suitable angular points for a triangulation could be found from Ross Island at the extreme north, to Hope Island at the extreme south of Spitzbergen, and to determine on a favourable locality for the measurement of a base-line. The result of the first year's exploration has been the selection of stations, on hills of moderate height and easy access from the coast, for nine triangles shown in the sketch accompanying Dr. Torell's paper, including Ross Island in the extreme north, and extending

over about 1° 50′ of the proposed arc of $4\frac{1}{2}$ degrees. A convenient locality has also been found for the base-line. The continuation of the preliminary survey to the extreme southern limit is to be the work of the summer of 1864. The report of the Geodesical Surveyors has shown that the northern portion presents no impediments which may not be surmounted by courage and perseverance; and with regard to the southern portion, the knowledge already acquired is considered to justify the expectation that the result of the second year's exploration will be no less favourable. Should such be the case, it is anticipated that the necessary steps will be taken for carrying into execution the measurement of the arc itself.

I may perhaps be permitted to allude for a moment to the peculiar interest with which I must naturally regard the proposed undertaking. The measurement of an arc of the meridian at Spitzbergen is an enterprise which nearly forty years ago was a cherished project of my own, which I had planned the means of executing, and which I ardently desired to be permitted to carry out personally. I may well therefore feel a peculiar pleasure in now seeing it renewed under what I regard as yet more promising auspices,—whilst I cannot but be sensible of how little I could have anticipated that I should have had the opportunity, at this distance of time, and from this honourable chair, of congratulating the Swedish Government and Academy upon their undertaking, and of thanking Dr. Torell for having traced its origination to my early proposition.

It is well remarked by Dr. Torell, that the triangulation, should it be proceeded with, will not be the only result of the years of scientific labour at Spitzbergen. There are, indeed, many important investigations for which the geographical circumstances would be eminently favourable. Two such may be specified, for which we may reasonably anticipate that full opportunity would be afforded, and for which the requisite instruments of precision are neither costly nor cumbersome. One is a more exact determination of the data on which our Tables of Astronomical Refraction are founded. The other is the employment of Cagnoli's method for determining the figure of the earth by occultations of the fixed stars*. This last would be tried under circumstances far more favourable than those contemplated by its original proposer, by reason of the high latitude of the northern observer—the greater number of stars in the moon's path, now included in our catalogues, of which a special ephemeris might be made —and the much greater amount of concerted corresponding observations which might now be secured. The advantage peculiar to this mode of determination is, that it is exempt from the influence of local irregularities in the direction and force of gravity which embarrass the results of

* Antonio Cagnoli, "Nuovo e sicuro mezzo per riconoscere la Figura della Terra," Memorie della Società Italiana, Verona, vol. vi. 1792.

An English translation, with Notes and an Appendix, was printed for private circulation in 1819, by Mr. Francis Baily.

the measurements of degrees and of pendulum experiments. As a third and thoroughly distinct method of investigation, it seems at least well deserving of a trial.

Swedish naturalists are not likely to undervalue the interest attaching to careful examinations of the constancy or variation of the elevation of land above the sea-level; and I may therefore venture to refer them to a paper in the Phil. Trans. for 1824 (Art. xvi.), written from Spitzbergen itself in July 1823, containing the particulars of a barometrical and trigonometrical determination of the height (approximately 1644 English feet) of the well-defined summit of a conspicuous hill in the vicinity of Fairhaven. The barometrical comparison was repeated on several days, the barometer on the summit of the hill being stationary, and the observation of the two barometers strictly simultaneous, the stations being visible from each other by a telescope. The height as given by the two methods, barometrical and trigonometrical, was in excellent accord. The hill may be identified with certainty by the plan which accompanies the paper referred to: it is of easy access, and may be remeasured with little difficulty.

It will be remembered that a few years ago the attention of the Royal Society was called by the Foreign Office to the circumstance of several glass bottles with closed necks having been found on the shores of the west coast of Nova Zembla, leading to a conjecture that they might afford some clue to the discovery of the missing ships of Sir John Franklin's Expedition. The inquiries instituted by the Royal Society traced the bottles in question to a recent manufacture in Norway, where they are used as floats to the fishing-nets employed on that coast. These floats, accidentally separated from the nets, had been carried by the stream-current which sets along the Norwegian coast round the North Cape, and thus afforded evidence of the prolongation of the current to Nova Zembla. The Swedish Expedition, in the course of its summer exploration, found on the northern shore of Spitzbergen several more of these bottle-floats, some of which even bore Norwegian marks and names, supplying evidence, of considerable geographical interest, of the extension of the Norwegian stream-current to Spitzbergen, either by a circuitous course past the shores of Nova Zembla, or by a more direct offshoot of which no previous knowledge existed. It is thus that step by step we improve our knowledge of the currents which convey the waters of the more temperate regions to the Polar seas and produce effects which are traceable in many departments of physical geography.

The application of gun-cotton to warlike purposes and engineering operations, and the recent improvements in its manufacture, have been the subject of a Report prepared by a joint Committee of the Chemical and Mechanical Sections of the British Association, consisting chiefly of Fellows of the Royal Society. The Report was presented at the Meeting in New-

castle in September last, and is now in the press. The Committee had the advantage of personal communication with General von Lenk, of the Imperial Austrian Artillery, the inventor of the system of preparation and adaptation by which gun-cotton has been made practically available for warlike purposes in the Austrian service. On the invitation of the Committee, and with the very liberal permission of the Emperor of Austria, General von Lenk visited England for the purpose of thoroughly explaining his system; and we have in the Report of the Committee the information, thus gained directly from the fountain-head, of the results of his experience in the course of trials extending over many years, together with additional investigations by individual members of the Committee.

The advantages which are claimed for gun-cotton over gunpowder for ordnance-purposes and mining-operations are so many and so important as to call imperatively for the fullest investigation. Such an inquiry, however, in its complete sense, is both beyond and beside the scope and purposes of a purely scientific body; and the British Association have done well (whilst reappointing the Committee to complete certain experiments which they had devised with the view of clearing up some scientific points which are still more or less obscure) in pressing on the attention of Her Majesty's Government the expediency of instituting under its own auspices a full and searching inquiry into the possible applications of gun-cotton in the public service.

The absence of smoke, and the entire freedom from the fouling of the gun, are points of great moment in promoting the rapidity of fire and the accuracy of aim of guns employed in casemates or in the between decks of ships of war; to these we must add the innocuous character of the products of combustion in comparison with those of gunpowder, and the far inferior heat imparted to the gun itself by repeated and rapid discharges. With equal projectile effects, the weight of the charge of gun-cotton is but one-third of that of gunpowder; the recoil is stated to be reduced in the proportion of 2 to 3, and the length of the gun itself to admit of a diminution of nearly one-third. These conclusions are based on the evidence of long and apparently very carefully conducted courses of experiment in the Imperial Factory in the neighbourhood of Vienna. The results appear to be especially deserving the attention of those who are engaged in the important problems of facilitating the employment of guns of large calibre and of great projectile force in the broadsides of our line-of-battle ships, and in reducing, as far as may be possible, the dimensions of the ports.

In the varied applications of explosive force in military or civil engineering, the details of many experiments which bear on this branch of the inquiry are stated in the Report of the Committee, and appear to be highly worthy of consideration and of further experiment.

It cannot be said that the advantages now claimed for gun-cotton are altogether a novel subject of discussion in this country. When the

material was first introduced by Schönbein in 1846, its distinctive qualities in comparison with gunpowder were recognized, although at that period they were far less well ascertained by experiment than they are at present. To the employment of gun-cotton as then known there was, however, a fatal drawback in its liability to spontaneous combustion. The elaborate experiments of General von Lenk have shown that this liability was due to imperfection in its preparation, and ceases altogether when suitable processes are adopted in its manufacture. Perfect gun-cotton is a definite chemical compound; and certain processes for the removal of all extraneous matter and of every trace of free acid are absolutely indispensable. But when thus prepared it appears to be no longer liable to spontaneous combustion, it can be transported from place to place with perfect security, or be stored for any length of time without danger of deterioration. It is not impaired by damp—and may be submerged without injury, its original qualities returning unchanged on its being dried in the open air and at ordinary temperatures.

A scarcely less important point towards the utilization of gun-cotton and the safety with which it may be employed in gunnery is the power of modifying and regulating its explosive energy at pleasure, by means of variations in the mechanical structure of the cartridge, and in the relative size of the chamber in which it is fired.

The experiments made by the Austrian Artillery Commission, as well as those for blasting and mining, were conducted on a very large scale; with small arms the trials appear to have been comparatively few.

There can be no hesitation in assenting to and accepting the concluding sentence of the Committee's report. "The subject has neither chemically nor mechanically received that thorough investigation that it deserves. There remain many exact measures still to be made, and many important data to be obtained. The phenomena attending the explosion of both gun-cotton and gunpowder have to be investigated, both as to the temperatures generated in the act of explosion and the nature of the compounds which result from them, under circumstances strictly analogous to those which occur in artillery practice."

I proceed to announce the awards which the Council has made of the Medals in the present year; and to state the grounds on which those awards have been made.

The Copley Medal has been awarded to the Reverend Adam Sedgwick, for his observations and discoveries in the Geology of the Palæozoic Series of Rocks, and more especially for his determination of the characters of the Devonian System, by observations of the order and superposition of the Killas Rocks and their Fossils, in Devonshire.

Mr. Sedgwick was appointed Woodwardian Professor of Geology in the University of Cambridge in the year 1818, since which time, up to a recent period, comprising an interval of upwards of forty years, he has

devoted himself to geological researches with an ability, a persistent zeal, and untiring perseverance which place him amongst the foremost of those eminent men by whose genius, sagacity, and labours the science of Geology has attained its present high position. To duly appreciate his earlier work as a geological observer and reasoner, we must recall to recollection the comparative ignorance which prevailed forty or fifty years ago, to the dispersion of which his labours have so largely contributed. Geology was then beset by wild and untenable speculations on the one hand, whilst on the other even its most calm and rational theories were received by many with distrust or with ridicule—and by others with aversion, as likely to interfere with those convictions on which the best hopes of man repose.

Under such circumstances Geology needed the support and open advocacy of men who, by their intellect and acquirements, and by the respect attached to their individual characters, their profession, or social position, might be able on the one hand to repress wild fancies, and on the other to rebut the unfounded assertions of those who opposed the discussion of scientific truth. Such a man was Professor Sedgwick, and such was the influence he exerted. It may be well to make this allusion on an occasion like the present, because it often happens, not unnaturally, that those who are most occupied with the questions of the day, in an advancing science, retain but an imperfect recollection of the obligations due to those who laid the first foundation of our subsequent knowledge.

More than forty years have passed since Professor Sedgwick began those researches among the older rocks of England which it became the main purpose of his life to complete. In 1822 was begun that full and accurate survey of the Magnesian Limestone of the North of England which to this day holds its high place in the estimation of geologists as the foundation of our knowledge of this important class of deposits, whether we regard their origin, form of deposition, peculiarities of structure, or organic contents.

Contemporaneously with this excellent work, he examined the Whin Sill of Upper Teesdale, showed its claims to be treated as a rock of fusion, and discussed the perplexed question of its origin.

Advancing to one of the great problems which occupied his thoughts for many years, he combined in 1831 the observations of the older rocks of the Lake Mountains which he had commenced in 1822, and added a special memoir on the great dislocations by which they are sharply defined and separated from the Pennine chain of Yorkshire. Memoirs followed in quick succession on the New Red Sandstone of the Vale of Eden; on the stratified and unstratified rocks of the Cumbrian Mountains, and on the Limestone and Granite Veins near Shap. Thus, thirty years since, before the names of Cambrian and Silurian were ever heard, under which we now thankfully class the strata of the English lakes, those rocks had been vigorously assailed and brought into a lucid order and system which is to this day unchanged, though by the same hands which laid the

foundations many important additions have been made, one of signal value in 1851—the lower palæozoic rocks at the base of the carboniferous chain between Ravenstonedale and Ribblesdale. Perhaps no district in the world affords an example of one man's researches begun so early, continued so long, and ending so successfully. By these persevering efforts, the Geology of the Lake district came out into the light; and there is no doubt, and can be no hesitation in ascribing to them the undivided honour of the first unrolling of the long series of deposits which constitute the oldest groups of British Fossiliferous Rocks.

Still more complete, however, was the success of that work which was undertaken immediately afterwards on the coeval rocks of Wales; by which Professor Sedgwick and Sir Roderick Murchison, toiling in separate districts, unravelled the intricate relations of those ancient rocks, and determined the main features of the successive groups of ancient life which they enclose. These labours began in 1831–32, and in 1835 the two great explorers had advanced so far in their research as to present a united memoir to the British Association in Dublin, showing the progress each had made in the establishment of the Cambrian and Silurian systems, as they were then called; Professor Sedgwick taking the former, and Sir Roderick Murchison the latter for his special field of study.

In 1843 Professor Sedgwick produced two memoirs on the structure of what he then termed the Protozoic rocks of North Wales. Many excellent sections were given in detail in these memoirs; those exhibiting the structure of the western part of the district about Carnarvonshire being principally taken from his observations in 1831–32, while the more detailed sections of the eastern part were from those of 1842–43. These two papers gave the complete outline or framework, as it were, of the geological structure of this intricate region. In several subsequent years he continued to fill up this outline with further details, observed almost entirely by himself, giving numerous general and local sections, by which he determined the dip and strike of the beds, normal and abnormal, and all the great anticlinal and synclinal lines on which the fundamental framework depends.

Further and still minuter details were subsequently given, as was to be expected, by the Government Surveyors; but the general arrangement, finally recognized on the map of the Survey, is essentially the same as that previously worked out by his unaided labours.

It was a principle always advocated by Professor Sedgwick, that the geological structure of a complicated district could never be accurately determined by fossils alone without a detailed examination of its stratification. He always proceeded on this principle; nor (from the paucity of organic remains) would it have been possible on any other principle to have determined the real geological character of those older districts which he investigated so successfully. His arrangement and nomenclature of the Cambrian rocks in North Wales (the Lower Silurians of Sir Roderick

Murchison) are given in his "Synopsis of the Classification of the British Palæozoic Rocks," 1855. It possesses the weight which must always be recognized as appertaining to the authority of the geologist who, by his own labours, first solved the great problem of the physical structure of the district.

There are other important memoirs of Professor Sedgwick's of which time forbids more than a very passing notice. The memoir "On the Structure of large Mineral Masses," published in 1831, was the first, and remains to this day the best descriptive paper which has yet appeared on joints, planes of cleavage, nodular concretions, &c.

Always attentive to the purpose of preparing a complete and general classification of the Palæozoic Strata, Professor Sedgwick at an early period in his career printed a memoir "On the Physical Structure of the Older Strata of Devon and Cornwall;" and another "On the Physical Structure of the Serpentine District of the Lizard." Of later date are several papers written by him, conjointly with Sir Roderick Murchison, respecting the Devonian System. The principal of these, published in 1840, comprised the work of several previous years, and made known the true nature of the *Culm Beds* of North Devon, as belonging to the Carboniferous series, and their position in a trough of the subjacent rocks, which rocks, on account of their position and their organic contents, were concluded to belong to the Devonian, or Old Red Sandstone period, a conclusion which was at first controverted, but was ultimately admitted. In another memoir by the same authors in 1828, they conclude that the coarse old red conglomerate along the north-western coast of Scotland and in Caithness is of about the same age as the Old Red Sandstone of South Wales and Herefordshire, and therefore of the Devonian period. They also published in 1840 an account of their general observations on the Palæozoic Formations of Belgium and the Banks of the Rhine, the results of which were considered to harmonize with those derived from other localities. Finally, we may notice another joint memoir by these authors in 1830, "On the Structure of the Eastern Alps," which, however, had no immediate relation to the researches on the Palæozoic formations.

It will be observed that the memoirs which have been noticed are for the most part pervaded by a certain unity of purpose. The investigations were not on points of merely local interest, but were essential for the elucidation of the geological history of our planet during those early periods of which the records are most difficult to unfold. Few persons perhaps can have an adequate idea of the difficulties he had to contend with when he first entered North Wales as a geologist. Geologically speaking, it was a *terra incognita* of which he undertook to read the geological history before any one had deciphered the characters in which it is written. Moreover, besides the indistinctness and complexity of the stratification, and the obscurity which then prevailed as to the distinction between planes of stratification and planes of cleavage, there was also the

difficulty of what may be called "mountain geometry"—that geometry by which we unite in imagination lines and surfaces observed in one part of a complicated mountain or district with those in another, so as to form a distinct geometrical conception of the arrangement of the intervening masses. This is not an ordinary power; but Mr. Sedgwick's early mathematical education was favourable to the cultivation of it. We think it extremely doubtful whether any other British geologist forty years ago could have undertaken, with a fair chance of success, the great and difficult work which he accomplished.

Such are the direct and legitimate claims of Professor Sedgwick to the honour conferred upon him by the award of the Copley Medal. But there are also other claims, less direct, but which it would be wrong to pass altogether unnoticed. It is not only by written documents that knowledge and a taste for its acquirement are disseminated; and those who have had the good fortune to attend Professor Sedgwick's lectures, or may have enjoyed social intercourse with him, will testify to the charm and interest he frequently gives to geology by the happy mixture of playful elucidation of the subject with the graver and eloquent exposition of its higher principles and objects.

Professor Sedgwick,

Accept this Medal, the highest honour which it is in the power of the Royal Society to confer, in testimony of our appreciation of the importance of the researches which have occupied so large a portion of your life, and which have placed you in the foremost rank of those eminent men by whose genius and labours Geology has attained its present high position in our country.

The Council has awarded a Royal Medal to the Reverend Miles Joseph Berkeley for his researches in Cryptogamic Botany, especially in Mycology.

Mr. Berkeley's labours as a cryptogamic botanist for upwards of thirty-five years, during which they have been more especially devoted to that extensive and most difficult order of plants the Fungi, have rendered him, in the opinion of the botanical members of the Council, by far the most eminent living author in that department. These labours have consisted in large measure of the most arduous and delicate microscopic investigation. Besides papers in various journals on Fungi from all parts of the globe, and in particular an early and admirable memoir on British Fungi, the volume entitled 'Introduction to Cryptogamic Botany,' published in 1857, is one which especially deserves to be noticed here. It is a work which he alone was qualified to write. It is full of sagacious remarks and reasoning; and particular praise is due to the special and conscientious care bestowed on the verification of every part, however minute and difficult, upon which its broad generalizations are founded. Mr. Berkeley's merits are not confined to description or classification; there

are facts of the highest significance, which he has been the first to indicate, and which in many cases he has also proved by observation and by experiments. We refer to his observations on the development of the reproductive bodies of the three orders of Thallogens (Algæ, Lichens, and Fungi), and on the conversion under peculiar conditions of certain forms of their fruit into others;—to the exact determination of the relations, and sometimes of the absolute specific identity of various forms of Fungi previously referred to different tribes; and to the recognition, in many species and genera, of a diversity of methods of reproduction in giving origin to parallel series of forms. As intimately connected with the life-history of Fungi, the intricate subject of vegetable pathology has been greatly elucidated by him; and he is indeed the one British authority in this department. His intimate acquaintance with vegetable tissues, and with the effects of external agents, such as climate, soil, exposure, &c., has enabled him to refer many maladies to their source; and to propose methods, which in some cases have proved successful, of averting, checking, and even curing diseases in some of our most valuable crops. In this line of research he has also demonstrated, on the one hand, that many so-called epiphytal and parasitic Fungi are nothing but morbid conditions of the tissues of the plant; on the other hand, that microscopic Fungi lurk and produce the most disastrous results where their presence had been least suspected.

Mr. Berkeley,

I present you with this Medal, in testimony of the high opinion which the Botanical Members of the Council of the Royal Society entertain of your researches in Cryptogamic Botany, especially Mycology; in which latter department your writings entitle you, in their judgment, to be considered as the most eminent living author.

The Council has awarded a Royal Medal to John Peter Gassiot, Esq., for his researches on the Voltaic Battery and Current, and on the Discharge of Electricity through Attenuated Media.

These contributions, most of which are recorded in our Transactions, are of high value, and in some respects peculiar. Their experimental part has been conducted on a scale of magnitude and power unmatched since the days of Davy and of Children, with apparatus of the highest perfection, and with consummate dexterity and skill; and the discussion and interpretation of the facts observed are characterized by sound theory and sober judgment.

It would trespass too much on your time were I to give a detailed account of them, and I shall only select a few which are examples of what Bacon has called "Instantiæ Crucis," such as, when the mind is undecided between several paths, point out the true one.

1. The first decides a question which was long debated with great vehemence, whether the energy of the Voltaic Battery arises from the contact of its metals, or from chemical action. The first of these opinions was mainly supported by the fact that, when two dissimilar metals are made to

touch, they show signs of opposite electricities when separated. Mr. Gassiot showed, in 1844, that the same occurs when the metals are separated by a thin stratum of air without having been in previous contact.

2. The identity of voltaic with frictional electricity was denied by many, because it gave no spark through an interval of air. Davy had indeed asserted the contrary in his 'Elements of Chemical Philosophy,' but his statement seems to have been doubted or unheeded. Mr. Gassiot, in the Transactions for 1844, has put the fact beyond dispute; he showed that by increasing the number of cells and carefully insulating them, sparks can be obtained even with the feeblest elements. With 3520 cells, zinc and copper excited with rain-water, he obtained sparks in rapid succession through $\frac{1}{50}$th of an inch of air; and a little later added to this a fact of still higher significance, that by exalting the chemical action in the cells, the same or even greater effect could be produced by a much smaller series. The battery of 500 Grove's cells which was constructed for these experiments is probably in some respects the most powerful that was ever made.

3. The currents produced by electric or magnetic induction are of the highest interest, and the employment of them as a source of electric power is almost daily enriching physical science with precious results. In this new field Mr. Gassiot has been one of the most successful explorers. So early as 1839 he showed that the induction current gives a real spark, and he found that in the flame of a spirit-lamp it could strike at a distance of $\frac{3}{4}$ths of an inch.

4. The splendid phenomena produced by the discharge of the induction current through rarefied gases or vapours are well known; in particular the stratification of the light. The cause of this is not yet fully understood, but Mr. Gassiot has made some very important additions to our knowledge of it in the Bakerian Lecture for 1858 and his subsequent communications to the Society. Among these may be named his explanation of the occasionally reversed curvature of the strata, and his discovery of the Reciprocating discharge, which, seeming single, is composed of two, opposite in direction, but detected by the different action of a magnet on each of them—a beautiful test, which is of wide application in such researches. Again, the Torricellian vacuum which he used at first, even when absolutely free from air, contains mercurial vapour: by applying to his tubes a potent freezing mixture, he found that as this vapour condensed, the strata vanished, the light and transmission of electricity decreased, till at a very low temperature both ceased entirely. It follows from this that a perfect vacuum does not conduct—a fact of cosmical importance, which had been surmised before, but not proved; and the desire of verifying this discovery led him to a means of far higher rarefaction. A tube containing a piece of fused hydrate of potassa is filled with dry carbonic acid, exhausted to the limit of the air-pump's power, and sealed; then by heating the potassa, the residual carbonic acid is mostly, or even totally absorbed. Vessels so exhausted, though still containing vapour of potassa, and perhaps of water, have a better vacuum than had been previously obtained, and often cease

to conduct till a little of the alkali is vaporized by heating them, and the gradual progress of the exhaustion gives a wide range of observation.

5. The current of an induction machine is necessarily intermittent, and it has been supposed that the strata are in some way caused by the intermittence, and are possibly connected with the mode of action of the contact-breaker. Mr. Gassiot has, however, shown that they are perfectly developed in the discharge of an extended voltaic battery through exhausted tubes. The large water-battery already mentioned shows them in great beauty; the discharge, however, is still intermittent.

6. The same appearance is exhibited by a Grove's battery of 400 well-insulated cells; but in this case a new and remarkable phenomenon presents itself. At first the discharge resembles that obtained from the water-battery, and is like it intermittent; but *suddenly* it changes its character from intermittent to continuous (so far at least as can be decided by a revolving mirror), and everything indicates that we have now the true voltaic arc. The discharge is now of dazzling brilliancy, *and is stratified as before*, whence it appears that strata are capable of being produced by the true arc discharge.

7. This change is accompanied by a remarkable alteration in the heating of the two electrodes. Mr. Gassiot had previously shown that, in the ordinary voltaic arc, formed in air of the usual pressure, the *positive* electrode is that which is the more heated, whilst in the discharge of an induction machine, whether sent through air at the ordinary pressure between electrodes of thin wire, or through an exhausted tube, it is the *negative*. The discharge through the large Grove's battery, so long as it was intermittent, agreed with the induction discharge in this character as in others, that the *negative* electrode was that which became heated; but when the discharge suddenly and spontaneously passed from the intermittent to continuous, the previously heated negative electrode became cool, and the positive was intensely heated.

These brief references will suffice to show what a high place Mr. Gassiot holds amongst those who are investigating this new track, which promises such great advance in our knowledge of those molecular forces in the study of which all physical science must ultimately centre. I may be permitted to add, that in his whole career he has sought not his own fame, but the advancement of science; he has rejoiced as much in the discoveries of others as in his own, and aided them by every appliance in his power. I cannot refrain from mentioning a recent instance in which this liberal and unselfish spirit has been strikingly exhibited. He has had executed a grand spectroscope, furnished with no less than nine faultless prisms, a design in which he has been ably seconded by the skill of the optician Mr. Browning, to whom the construction was entrusted. This magnificent instrument he has placed at the disposal of any Fellow of the Society who may happen to be engaged in researches requiring the use of such powerful apparatus. The instrument is at present at the Kew Observatory, where it is in contemplation to undertake the construction of a highly elaborate map of the spectrum.

Mr. Gassiot is still pursuing his electrical researches, and we may be assured that he will feel this acknowledgment of his labours by the Royal Society not merely as a recompense for that he has accomplished, but as an obligation to continued exertion and new discoveries.

MR. GASSIOT,

You will receive this Medal as a mark of the deep interest which the Royal Society takes in the investigations in which you are engaged, and of the high value which it attaches to the results with which you have already enriched our Transactions.

These are the grounds on which the Medal has been awarded to you by the Council. But it may be permitted to me to express the hope that you will also associate with it—as it is impossible that we should not do—the Society's recognition of the generous and kindly spirit which has manifested itself, as elsewhere, so also in all your pursuit of Science; and of which one memorial amongst others will remain in future times connected with the Society, in the establishment of the Scientific Relief Fund.

On the motion of Professor Owen, seconded by Mr. Gwyn Jeffreys, it was resolved—"That the thanks of the Society be returned to the President for his Address, and that he be requested to allow it to be printed."

The Statutes for the election of Council and Officers having been read, and Dr. W. Farr and Mr. Evans having been, with the consent of the Society, nominated Scrutators, the votes of the Fellows present were collected, and the following were declared duly elected as Council and Officers for the ensuing year:—

President.—Major-General Edward Sabine, R.A., D.C.L., LL.D.

Treasurer.—William Allen Miller, M.D., LL.D.

Secretaries.—William Sharpey, M.D., LL.D.; George Gabriel Stokes, Esq., M.A., D.C.L.

Foreign Secretary.—Prof. William Hallows Miller, M.A.

Other Members of the Council.—James Alderson, M.D.; George Busk, Esq., Sec. L.S.; Col. Sir George Everest, C.B.; Hugh Falconer, M.A., M.D.; John Hall Gladstone, Esq., Ph.D.; Joseph Dalton Hooker, M.D.; Henry Bence Jones, M.A., M.D.; Prof. James Clerk Maxwell, M.A.; Prof. William Pole, C.E.; Archibald Smith, Esq., M.A.; Prof. Henry J. Stephen Smith, M.A.; The Earl Stanhope, P.S.A., D.C.L.; Prof. James Joseph Sylvester, M.A.; Thomas Watson, M.D., D.C.L.; Prof. Charles Wheatstone, D.C.L.; Rev. Prof. Robert Willis, M.A.

On the motion of Mr. Brayley, seconded by Mr. Balfour Stewart, the thanks of the Society were voted to the Scrutators. The Society then adjourned.

Receipts and Payments of the Royal Society between December 1, 1862, *and November* 30, 1863.

	£	s.	d.
Balance at Bank, and on hand	635	7	3
Annual Subscriptions and Compositions	1740	8	0
Rents	354	2	8
Dividends on Stock	922	5	10
Ditto, Ditto, Trust Funds	281	7	0
Ditto, Ditto, Stevenson Bequest	466	7	0
Sale of Transactions, Proceedings, &c.	440	19	7
Chemical Society, Proceedings, 1861–63 (2 years)	100	0	0
Tea Expenses and Gas, repaid	77	17	2
Parcel Charges recovered	14	15	9
Sale of £107 13*s.* 5*d.* Consols (Rumford Fund)	100	0	0

Estates and Property of the Royal Society, including Trust Funds.

Estate at Mablethorpe, Lincolnshire (55 A. 2 R. 2 P.), £117 6*s.* 4*d.* per annum.

Estate at Acton, Middlesex (34 A. 3 R. 11 P.), £110 0*s.* 0*d.* per annum.

Fee farm rent in Sussex, £19 4*s.* per annum.

One-fifth of the clear rent of an estate at Lambeth Hill, from the College of Physicians, £3 per annum.

£14,000 Reduced 3 per Cent. Annuities.

£26,969 15*s.* 7*d.* Consolidated Bank Annuities.

£513 9*s.* 8*d.* New 2½ per Cent. Stock.

£5133 10 3

	£	s.	d.
Salaries, Wages, and Pension	996	9	0
The Scientific Catalogue	194	10	9
Books for the Library and Binding	198	15	10
Printing Transactions and Proceedings, Paper, Binding, Engraving, and Lithography	2292	11	3
Upholstery, Painting, and Miscellaneous House Expenses	66	16	5
Coal and Lighting	97	5	2
Tea Expenses	53	3	6
Fire Insurance	42	1	6
Shipping Expenses	23	12	9
Fittings and Gas for Illumination	33	2	6
Taxes	16	6	3
Law Expenses	11	4	4
Stationery	6	8	9
Postage, Parcels, and Petty Charges	27	10	0
Subscription, Mablethorpe Schools	2	2	0
Donation Fund	126	19	5
Rumford Fund	237	10	4
Wintringham Fund	34	13	0
Copley Medal Fund	4	15	1
Mr. Sorby, Bakerian Lecture	3	17	0
Prof. Lister, Croonian Lecture	2	17	6
Rev. T. S. Evans, Fairchild Lecture	2	17	10
Balance at Bank	641	14	0
,, Catalogue Account	10	3	9
,, Petty Cash ,,	6	2	4
	£5133	10	3

WILLIAM ALLEN MILLER,
Treasurer.

Statement of Income and Expenditure (apart from Trust Funds) during the Year ending November 30, 1863.

	£	s.	d.
Annual Subscriptions	1144	8	0
Admission Fees	190	0	0
Compositions	406	0	0
Rents	354	2	8
Dividends on Stock (exclusive of Trust Funds)	922	5	10
„ on Stevenson Bequest	466	7	0
Sale of Transactions, Proceedings, &c.	440	19	7
Chemical Society, for Proceedings, 1862–63	50	0	0
Chemical Society, Tea Expenses 14 6 4			
Geological Society, Tea Expenses and Gas £15 5 10			
Linnean Society, Tea Expenses..... 14 6 4			
Chemical, Geographical, and Linnean Societies, and University, part cost of Illumination, £6 each 24 0 0	77	17	2
Geographical Society, Gas at Evening Meetings 9 0 0			
Social Science Association, and St. George's Rifles, ditto..... 0 18 8			
Parcel Charges recovered	14	15	9
	4066	16	0
Receivable on this Year's account.			
Miss Burdett Coutts Half cost of Plates to Dr. Heer's and Mr. Pengelly's Papers	90	0	0
Income available for the Year ending Nov. 30, 1863	4156	16	0
Expenditure in the Year ending Nov. 30, 1863	4062	0	0
Excess of Income over Expenditure in the Year ending Nov. 30, 1863	£94	16	0

	£	s.	d.
Salaries, Wages, and Pension	996	9	0
The Scientific Catalogue	194	10	9
Books for the Library £109 18 11			
Binding ditto..... 88 16 11	198	15	10
Printing Transactions, Parts I. & II. 1862, and Part I. 1863 ..... 835 13 11			
Ditto Proceedings, Nos. 52–57 ..... 209 15 0			
Ditto Miscellaneous 110 11 8	2292	11	3
Paper for Transactions and Proceedings ... 328 7 4			
Binding and Stitching ditto..... 95 17 10			
Engraving and Lithography 712 5 6			
Painting and Cleaning	20	6	4
Upholstery, Repairs, and Miscellaneous House Expenses	46	10	1
Coal and Lighting	97	5	2
Tea Expenses	53	3	6
Fire Insurance	42	1	6
Fittings and Gas for Illumination	33	2	6
Shipping Expenses	23	12	9
Taxes	16	6	3
Law Expenses	11	4	4
Stationery	6	8	9
Postage, Parcels, and Petty Charges	27	10	0
Subscription to Mablethorpe Schools	2	2	0
WILLIAM ALLEN MILLER, *Treasurer.*	£4062	0	0

Scientific Relief Fund.

Investments up to July 1863, New 3 per Cent. Annuities	£5300 0 0
	£5300 0 0

Dr.	£	s.	d.	*Cr.*	£	s.	d.
To Subscriptions and Dividends.....	377	17	0	By Grants	75	0	0
				Purchase of Stock.....	74	9	0
				Balance	228	8	0
	£377	17	0		£377	17	0

The following Table shows the progress and present state of the Society with respect to the number of Fellows:—

	Patron and Honorary.	Foreign.	Having compounded.	Paying £2 12s. annually.	Paying £4 annually.	Total.
December 1, 1862..	5	49	327	4	275	660
Since compounded..	.....	.....	+2	.....	−2	
Since elected	+1	+3	+7	.....	+11	+22
Since admitted	.....	.....	.....	.....	+1	+1
Since readmitted ..	.....	.....	.....	.....	+1	+1
Since withdrawn ..	.....	.....	.....	.....	−2	−2
Since deceased	.....	−3	−12	.....	−10	−25
November 30, 1863.	6	49	324	4	274	657